Claims:

1. A data transmission apparatus for transmitting data packets from an upper layer side device to a lower layer side device, comprising:

a first receiving means for receiving the data packets from said upper layer side device, and converting said data packets to a first type of frames;

a first processing means for encapsulating said first type of frames to form a second type of frames containing a SAPI field including a SAPI identifier and an information field including said data packets;

a second processing means for encapsulating said second type of frames into a payload portion, inserting appropriate overheads corresponding to said data packets, so as to form a third type of frames; and

a first transmitting means for outputting said third type of frames to the lower layer side device.

2. The data transmission apparatus according to claim 1, wherein said first processing means encapsulates said first type of frames into a format of start flag, SAPI field including SAPI identifier as address field, control field, information field including said data packets, FCS field, and end flag, to form a second type of frames.

3. The data transmission apparatus according to claim 2, wherein said SAPI field is of one single octet, and said control field is of one single octet.

4. The data transmission apparatus according to claim 1, wherein said first processing means encapsulates said first type of frames into a format of start flag, address field, control field, SAPI field including said SAPI identifier, information field including said data packets, FCS field, and end flag, to form a second type of frames.

5. The data transmission apparatus according to claim 4, wherein said address field is of one single octet, said control field is of one single octet, and said SAPI field is of two octets.

6. The data transmission apparatus according to claim 3 or 5, wherein said first receiving means is a first FIFO for receiving and buffering the input data packets, and adapting the rate of said upper layer side device to the rate of said lower layer side device.

7. The data transmission apparatus according to claim 6, further comprising a scrambling means for performing scrambling to said second type of frames with a frame synchronous scrambling sequence generated from a polynomial $g(x)=x^7+1$.

8. The data transmission apparatus according to claim 7, further comprising a pointer processing means for inserting pointer which indicates the start position of the payload portion in said third type of frames.

9. The data transmission apparatus according to claim 8, further comprises a framing means for encapsulating the scrambled second type of frames into said third type of frames.

10. The data transmission apparatus according to claim 9,wherein said start flag and end flag of the second type of frames are "0x7E", and said 0x7E shall be transmitted during inter-frame time fill.

11. The data transmission apparatus according to claim 10, wherein said first processing means performs transparency processing (octet stuffing).

12. The data transmission apparatus according to claim 11, wherein said first processing means calculates 32 bit frame check sequence field over all octets within the frame except the start flag and the end flag and the FCS field itself, with generating polynomial: $1 + x + x^2+ x^4+ x^5+ x^7+x^8+ x^{10}+ x^{11}+ x^{12}+ x^{16}+ x^{22}+ x^{23}+ x^{26}+ x^{32}$.

13. The data transmission apparatus according to claim 12, wherein said payload portion includes one sub-portion or more than one sub-portions of payload for carrying said first type of frames.

14. The data transmission apparatus according to claim 1, wherein said first processing obtains the SAPI from said first receiving means.

15. The data transmission apparatus according to claim 3 or 5, wherein the end flag of a previous second type of frame is the start flag of a subsequent second type of frame.

16. The data transmission apparatus according to claim 1, further comprising a line side packet loopback means for loopbacking the first type of frames extracted from the second frames into said first processing means for test purpose.

17. The data transmission apparatus according to claim 13, wherein said payload portion is a virtual container or contiguous and virtual concatenation of virtual containers, and virtual containers as the sub-portions of payload.

18. The data transmission apparatus according to any one of the preceding claims, wherein said overheads include Path Trace(J1), path BIP-8(B3), signal label(C2) Path status(G1) in a way of single virtual container or concatenation.

19. The data transmission apparatus according to any one of the claims1 to 17, wherein said physics layer is of SDH/SONET or simplified SDH/SONET.

20. The data transmission apparatus according to any one of the claims1 to 17, wherein said upper layer is Ethernet MAC layer, said first type of frames are MAC frames, said second type of frames are LAPS frames, and the third type of frames are SDH/SONET frames.

21. The data transmission apparatus according to any one of the claims 1 to17, wherein said data transmission apparatus is built in a SDH/SONET transmission device.

22. The data transmission apparatus according to any one of the claims 1 to 17, wherein said data transmission apparatus is built in an Ethernet switch device.

23. The data transmission apparatus according to any one of the claims 1 to 17, wherein said data transmission apparatus is an Ethernet switch device or an Ethernet/Fast Ethernet/Gigabit Ethernet L2/L3 switch or associated router.

24. The data transmission apparatus according to claim 22, wherein said Ethernet switch device is an Ethernet/Fast Ethernet/Gigabit Ethernet L2/L3 switch or associated router.

25. The data transmission apparatus according to any one of the claims19 to 24, wherein

said data transmission apparatus maps the received MAC/GMAC frame from MII/GMII to the SDH/SONET block through transformer synchronously.

26. The data transmission apparatus according to any one of the claims 19 to 24, wherein said data transmission apparatus, for the purpose of rate adaptation, adds the programmable rate adaptation Gap fill byte (0xdd) into said second type of frames in a form of {0x7d, 0xdd} if necessary.

27. A data transmission method for transmitting data packets from an upper layer side device to a lower layer side device, comprising steps of:
receiving and buffering the data packets from said upper layer side device, adapting the rate of said upper layer side device to the rate of said lower layer side device, and converting said data packets to a first type of frames;
encapsulating said first type of frames to form a second type of frames containing a SAPI field including a SAPI identifier and an information field including said data packets;
encapsulating said second type of frames into a payload portion, inserting appropriate overheads of said data packets, so as to form a third type of frames; and
outputting said third type of frames to the lower layer side device.

28. The data transmission method according to claim 27, wherein said first type of frames are encapsulated into a format of start flag, SAPI field including SAPI identifier as address field, control field, information field including said data packets, FCS field, and end flag, to form a second type of frames.

29. The data transmission method according to claim 28, wherein said SAPI field is of one single octet, and said control field is of one single octet.

30. The data transmission method according to claim 27, wherein said first type of frames are encapsulated into a format of start flag, address field, control field, SAPI field including said SAPI identifier, information field including said data packets, FCS field, and end flag, to form a second type of frames.

31. The data transmission method according to claim 30, wherein said address field is of one single octet, said control field is of one single octet, and said SAPI field is of two octets.

32. The data transmission method according to claim29 or 31, further comprising a step of performing scrambling to said second type of frames with a frame synchronous scrambling sequence generated from a polynomial $g(x)=x^7+1$.

33. The data transmission method according to claim 32, further comprising a step of inserting pointer which indicates the start position of the payload portion in said third type of frames.

34. The data transmission method according to claim 33, further comprises a step of encapsulating the scrambled second type of frames into said third type of frames.

35. The data transmission method according to claim 34, wherein said start flag and end flag are "0x7E", and said data transmission method further comprises a step of transparency processing (octet stuffing).

36. The data transmission method according to claim 35, further comprising a step of calculating 32 bit frame check sequence field over all octets within the frame except the start flag and the end flag and the FCS field itself, with generating polynomial: $1 + x + x^2+ x^4+ x^5+ x^7+x^8+ x^{10}+ x^{11}+ x^{12}+ x^{16}+ x^{22}+ x^{23}+ x^{26}+ x^{32}$.

37. The data transmission method according to claim 36, wherein said payload portion includes a plurality of sub-portions of payload for carrying said first type of frames.

38. The data transmission method according to claim 29 or 31, wherein the end flag of a previous frame is the start flag of a subsequent frame.

39. The data transmission method to claim 27, wherein said payload portion is a virtual container or contiguous and virtual concatenation of virtual containers, and virtual containers as the sub-portions of payload.

40. The data transmission method according to any one of the claims27 to 39, wherein said overheads include Path Trace(J1), path BIP-8(B3), signal label(C2) Path status(G1) in a way of single virtual container or concatenation.

41. The data transmission method according to any one of the claims 27 to 39, wherein said physics layer is of SDH/SONET or simplified SDH/SONET.

42. The data transmission method according to any one of the claims 27 to 39, wherein said upper layer is Ethernet MAC/GMAC layer, said first type of frames are MAC/GMAC frames, said second type of frames are LAPS frames, and the third type of frames are SDH/SONET frames.

43. The data transmission method according to claim 42, wherein said Ethernet layer is an Ethernet layer of IEEE802.3/802.3u/802.3z.

44. The data transmission method according to any one of the claims 41 to 43, further comprises a step of synchronizing the received MAC/GMAC frame from MII/GMII to the SDH/SONET block through transformer.

45. The data transmission method according to any one of the claims 41 to 43, for the purpose of rate adaptation, further comprises a step of adding the programmable rate adaptation Gap fill byte (0xdd) into said second type of frames in a form of {0x7d, 0xdd}.

46. A data transmission apparatus for transmitting data packets formed by a first type of frames from a lower layer side device to an upper layer side device, said apparatus comprising:

a second receiving means for receiving the data packets from said lower layer side device;

a de-framing means for removing the overheads of said first type of frames;

a third processing means for extracting a SAPI field and the data contained in the information field from the payload portion of said first type of frames, to form a second type of frames;

a determining means for comparing the value of the SAPI field with a preset value, and determining to output the extracted data as it be if the value of the SAPI field data equals to said preset value;

a fourth processing means for converting said second type of frames to a third type of frames corresponding to in said data packets; and

a second transmitting means for transmitting the extracted data packets to said upper layer side device.

47. The data transmission apparatus according to claim 46, wherein each of said second type of frames including start flag, SAPI field, control field, information field, FCS field, and end flag.

48. The data transmission apparatus according to claim 47, wherein said SAPI field is of one single octet, and said control field is of one single octet.

49. The data transmission apparatus according to claim 46, wherein each of said second type of frames includes start flag, address field, control field, SAPI field including a SAPI identifier, information field including said data packets, FCS field, and end flag.

50. The data transmission apparatus according to claim 49, wherein said address field is of one single octet, said control field is of one single octet, and said SAPI field is of two octets.

51. The data transmission apparatus according to claim 46, wherein said second transmitting means is a second FIFO for receiving and buffering the input data packets, and adapting the rate of said lower layer side device to the rate of said upper layer side device.

52. The data transmission apparatus according to claim 51, further comprising a descrambling means for performing descrambling to said first type of frames with a frame synchronous scrambling sequence generated from a polynomial $g(x)=x^7+1$.

53. The data transmission apparatus according to claim 52, further comprising a pointer processing means for locating the start of the payload portion encapsulated in the third type of frames indicated by the pointer.

54. The data transmission apparatus according to claim 53, wherein said start flag and end flag are "0x7E".

55. The data transmission apparatus according to claim 54, wherein said de-framing means removes inter-frame fill, and wherein said de-framing means performs procedure of transparency processing.

56. The data transmission apparatus according to claim 55, wherein the received FCS field is verified by calculating FCS checksum over all octets between the start flag and the end flag with generating polynomial: $1 + x + x^2 + x^4 + x^5 + x^7 + x^8 + x^{10} + x^{11} + x^{12} + x^{16} + x^{22} + x^{23} + x^{26} + x^{32}$.

57. The data transmission apparatus according to claim 56, further comprises a overhead monitoring means for monitoring the overheads in said first type of frames for errors in states during the data receiving.

58. The data transmission apparatus according to claim 57, wherein said payload portion includes a plurality of sub-portions of payload for carrying said first type of frames.

59. The data transmission apparatus according to claim 58, wherein the end flag of a previous frame is the start flag of a subsequent frame next to said previous frame.

60. The data transmission apparatus according to claim 59, wherein said payload portion is a virtual container or contiguous and virtual concatenation of virtual containers, and virtual containers as the sub-portions of payload.

61. The data transmission apparatus according to any one of the claims46 to 60, wherein said overheads include Path Trace(J1), path BIP-8(B3), signal label(C2) Path status(G1).

62. The data transmission apparatus according to any one of the claims 46 to 60, wherein said physics layer is of SDH/SONET or simplified SDH/SONET.

63. The data transmission apparatus according to any one of the claims 46 to 60, wherein said upper layer is Ethernet MAC/GMAC layer, said first type of frames are SDH/SONET

frames, said second type of frames are LAPS frames, and the third type of frames are MAC/GMAC frames.

64. The data transmission apparatus according to any one of the claims 46 to 60, wherein said data transmission apparatus is built in a SDH/SONET transmission device.

65. The data transmission apparatus according to any one of the claims 46 to 60, wherein said data transmission apparatus is built in an Ethernet switch device.

66. The data transmission apparatus according to any one of the claims 46 to 60, wherein said data transmission apparatus is an Ethernet switch device or an Ethernet/Fast Ethernet/Gigabit Ethernet L2/L3 switch or associated router.

67. The data transmission apparatus according to any one of the claims 46 to 60, wherein said Ethernet switch device is an Ethernet/Fast Ethernet/Gigabit Ethernet L2/L3 switch or associated router.

68. The data transmission apparatus according to any one of the claims 62 to 67, wherein said data transmission apparatus, for the purpose of rate adaptation, removes the programmable rate adaptation Gap fill byte existed in said second type of frames in a form of {0x7d, 0xdd}.

69. The data transmission apparatus according to any one of the claims 62 to 67, wherein said data transmission apparatus synchronizes the LAPS information field (MAC/GMAC frame) from SDH/SONET block to-RX_CLK at MII/GMII interface through transformer.

70. A data transmission method for transmitting data packets formed by a first type of frames from a lower layer side device to an upper layer side device, said apparatus comprising steps of:

receiving the data packets from said lower layer side device;

removing the overheads of said first type of frames;

extracting a SAPI field and the data contained in the information field from the payload portion of said first type of frames, to form a second type of frames;

comparing the value of the SAPI field with a preset value, and determining to output the extracted data as it be if the value of the SAPI field data equals to said preset value;

converting said second type of frames to a third type of frames corresponding to in said data packets; and

transmitting the extracted data packets to said upper layer side device.

71. The data transmission method according to claim 70, wherein each of said second type of frames including start flag, SAPI field, control field, information field, FCS field, and end flag.

72. The data transmission method according to claim 71, wherein said SAPI field is of one single octet, and said control field is of one single octet.

73. The data transmission method according to claim 70, wherein each of said second type of frames includes start flag, address field, control field, SAPI field including a SAPI identifier, information field including said data packets, FCS field, and end flag.

74. The data transmission method according to claim 73, wherein said address field is of one single octet, said control field is of one single octet, and said SAPI field is of two octets.

75. The data transmission method according to claim 72 or 74, further comprises of a step of receiving and buffering the input data packets, and adapting the rate of said lower layer side device to the rate of said upper layer side device.

76. The data transmission method according to claim 75,further comprising a step of performing descrambling to said first type of frames with a frame synchronous scrambling sequence generated from a polynomial $g(x)=x^7+1$.

77. The data transmission method according to claim 76, further comprising a step of locating the start of the payload encapsulated in the first type of frames indicated by the pointer.

78. The data transmission method according to claim 77, wherein said start flag and end flag are "0x7E", and said data transmission method further comprises a step of removing inter-frame fill.

79. The data transmission method according to claim 78, wherein the received FCS field is verified by calculating FCS checksum over all octets between the start flag and the end flag with generating polynomial: $1 + x + x^2 + x^4 + x^5 + x^7 + x^8 + x^{10} + x^{11} + x^{12} + x^{16} + x^{22} + x^{23} + x^{26} + x^{32}$.

80. The data transmission method according to claim 79, further comprises a step of monitoring the overheads in said third type of frames for errors in states during the data receiving.

81. The data transmission method according to claim 80, wherein said payload portion includes a plurality of sub-portions of payload carried by said first type of frames.

82. The data transmission method according to claim 81, wherein the end flag of a previous frame is the start flag of a subsequent frame.

83. The data transmission method according to claim 82, wherein said payload portion is a virtual container or contiguous and virtual concatenation of virtual containers, and virtual containers as the sub-portions of payload.

84. The data transmission method according to any one of the claims70 to 83, wherein said overheads include Path Trace(J1), path BIP-8(B3), signal label(C2) Path status(G1) in a way of single virtual container or concatenation.

85. The data transmission method according to any one of the claims 70 to 83, wherein said physics layer is of SDH/SONET or simplified SDH/SONET.

86. The data transmission method according to any one of the claims 70 to 83, wherein said upper layer is Ethernet MAC/GAMC layer, said first type of frames are SDH/SONET frames, said second type of frames are LAPS frames, and the third type of frames are MAC/GMAC frames.

87. The data transmission method according to claim 86, wherein said Ethernet layer is an Ethernet layer of IEEE802.3/802.3u/802.3z.

89. The data transmission method according to any one of the claims85 to 87, for the purpose of rate adaptation, further comprises a step of removing the programmable rate adaptation Gap fill byte existed in said second type of frames in a form of {0x7d, 0xdd}.

90. The data transmission method according to any one of the claims 85 to 87, further comprises a step of synchronizing the LAPS information field (MAC/GMAC frame) from SDH/SONET block to-RX_CLK at MII/GMII interface through transformer.

91. A data interfacing apparatus for transmitting data packets between a upper layer side device and a lower layer side device comprising the data transmission apparatus according to any one of claims 1 to 26 and data transmission apparatus according to any one of claim 46 to 69.

92. The data interfacing apparatus according to claim 91, further comprising a line side interfacing means for transmitting/receiving data packets from lower layer side device.

93. The data interfacing apparatus according to claim 92, further comprising a transforming means for synchronizing the data packets of said upper layer side device with data packets input to said first receiving means in the transmission direction, and for synchronizing the extracted data packets from said second transmitting means with the data packets of said upper layer side device in the receiving direction.

94. The data interfacing apparatus according to claim 93, further comprising a microprocessor interfacing means for enabling said data interfacing apparatus to access all registers within it; a JTAG port for testing; and a GPIO register for temporal buffering input/output configuration data.